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## **A straight forward procedure to extract the volcanic cloud top height as a Plume Elevation Model (PEM) from already Orthorectified Landsat 8 images. Application to the 26 October 2013 Mt Etna eruption (Italy) and cross comparison with Lagrangian trajectories, Modis and Iasi data**

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The retrieval of Volcanic Cloud Top Height (VCTH) in the form of a Plume Elevation Model (PEM) from the high resolution push broom OLI sensor (Operational Land Imager) onboard Landsat-8 satellite, has been demonstrated in de Michele et al. (2016) starting from raw data. The core of de Michele et al. (2016) method lies on the physical distance between the panchromatic sensor (PAN) and the multi-spectral sensors (MS), which yields a baseline and a time lag between the PAN and MS images acquisitions during a single passage of the satellite. This information can be used to extract a spatially detailed map of VCTHs from potentially every multi spectral push broom system, which is named Plume Elevation Model.

The main difficulty of data processing stands in the fact that one Landsat image consists of 14 focal plane modules (FPMs) arranged in the so called 'staggered' geometry, which makes the joint retrieval of plume velocities and heights challenging. De Michele et al. (2016) overcome this issue by reconstructing a new OLI starting from raw OLI data. Nevertheless, the application of this method is in some way limited because the raw Landsat-8 provided by USGS is not the ortho standard product. In this study, we first adapt then apply the methodology of de Michele et al. (2016) to standard ortho Landsat-8 data, with the aim of simplifying the procedure and make it more widely usable. Secondly, we quantitatively compare the VCTH extracted from the PEM to Lagrangian trajectory modeling and independent measurements from, MODIS and IASI.

This study is based on the 26 October 2013 Mt Etna eruption (e.g. Sellitto et al., ACP, 2016). On the morning of 26 October 2013, the New Southeast Crater (NSEC) of Mt. Etna displayed the 39th lava fountain episode of the sequence started in 2011. Eruption started on the early morning of the 25 October displaying strombolian activity from the summit south-crater and to climax on 26 October in the paroxysmal stage coupled with a lava flow which spread towards the Valle del Bove. A column of gas and ash rose several kilometers above the summit of the volcano and was then blown by the wind toward southwest. Paroxysmal stage ceased at 10:00 gmt but eruption continued till the late evening. PEM results applied to this eruptive event show a volcanic cloud altitude varying from 5 km (injection height) up to 9.5 km evolving in the South West direction. These results are in agreement with a preliminary comparison with independent measurements from IASI and MODIS. The complementarity between these methods provides an improved volcanic cloud monitoring.